Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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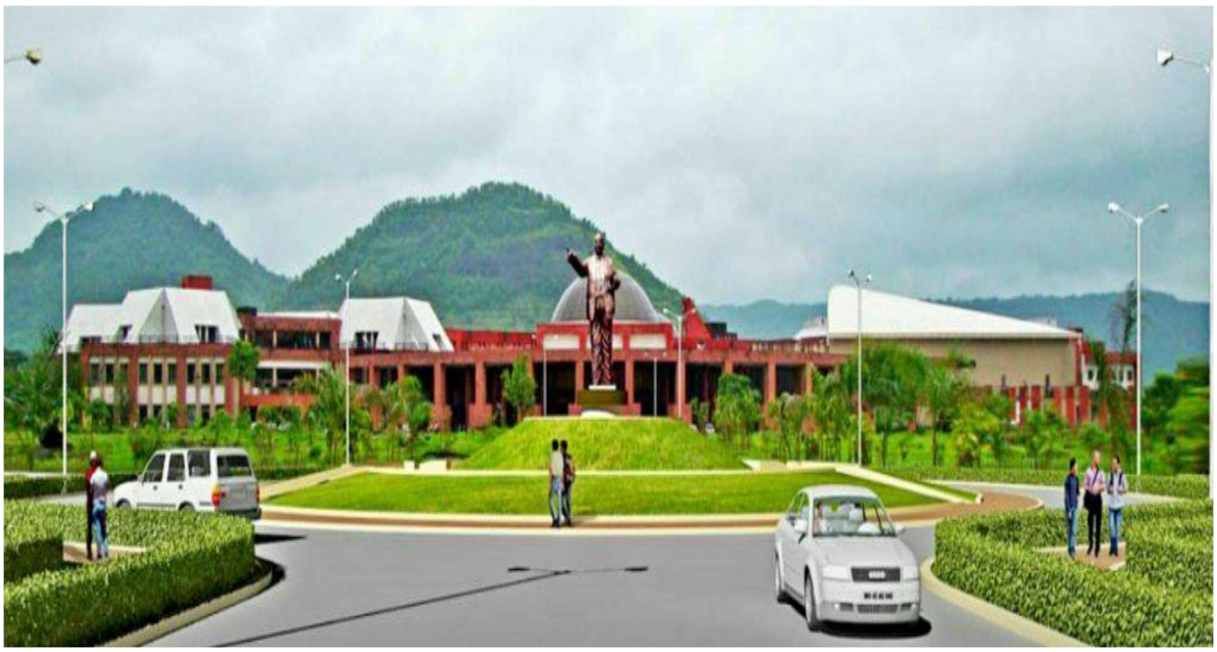
Draft Copy of Curriculum for Undergraduate Degree Programme

B. Tech. in Civil Engineering

With effect from (Fourth Year) AY 2023-24



Dr. Babasaheb Ambedkar Technological University

B.Tech. Civil Engineering

Course Structure for Semester VII (Fourth Year) w.e.f. 2023-2024

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTCVC701	**Core**	Design of Reinforced & Prestressed Concrete Structures	3	1	--	20	20	60	100	4
BTCVC702	**Core**	Infrastructure Engineering	3	--	--	20	20	60	100	3
BTCVC703	**Core**	Construction Techniques	3	--	--	20	20	60	100	3
BTCVC704	**Core**	Professional Practices	3	1	--	20	20	60	100	4
BTCVE705A	**Elective IV**	Engineering Economics	3	--	--	20	20	60	100	3
BTCVE705B		Finite Element Method								
BTCVE705C		Limit State Design of Steel Structures								
BTCVE705D		Rock Mechanics								
BTCVE705E		Applications of Drone Technology								
BTCVE705F		Advanced RC Design								
BTCVE705G		Applied Hydrology & Flood Control								
BTCVE705H		Legal Aspects in Civil Engineering Contracts								
BTCVE705I		Bridge Engineering								
BTCVOE706A	**Open Elective V**	Advanced Structural Analysis	3	--	--	-	--	--	--	Audit
BTCVOE706B		Air Pollution Control								
BTCVOE706C		Applications of AI and ML in Civil Engineering								
BTCVOE706D		Introduction to Earthquake Engineering								
BTCVOE706E		Internet of Things								
BTCVOE706F		Tunneling and Underground Excavations								
BTCVOE706G		Bamboo Construction Technology								
BTHM707A		Essence of Indian Traditional Knowledge	2	--	--	--	--	--	--	Audit
BTHM707B		Foreign language##								
BTCVL708		Design & Drawing of Prestressed Concrete	--	--	2	30	--	20	50	1

	Lab.	Structures								
BTCVL709		Professional Practices	--	--	2	30	--	20	50	1
BTCVP610	Training	Field Training / Internship/Industrial **Evaluation**	--	--	--	--	--	50	50	1
BTCVS710	BTS	Seminar	--	--	2	--	--	50	50	1
BTCVP711	BTP	Project Stage-I**	--	--	4	--	50	50	100	3
		Total	**20**	**2**	**10**	**160**	**150**	**490**	**800**	**24**

B.Tech. Civil Engineering

Course Structure for Semester VIII [Fourth Year] w.e.f. 2023-2024

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme$				Credits
			L	T	P	CA	MSE	ESE	Total	
BTCVSS801A	(Self-Study Course) #	Characterization of Construction Materials	02**	--	--	20	20	60	100	3
BTCVSS801B		Geo synthetics and Reinforced Soil Structures								
BTCVSS801C		Higher Surveying								
BTCVSS801D		Maintenance and Repair Of Concrete Structures								
BTCVSS801E		Structural Dynamics								
BTCVSS801F		Engineering Systems & Development								
BTCVSS801G		Sustainable River Basin Management								
BTCVSS801H		Modern Construction Materials								
BTCVSS801J		Advanced Town & Urban Planning								
BTCVSS802A	(Self-Study Course) #	Energy Efficiency Acoustics and Day lighting in Building	02**	--	--	20	20	60	100	3
BTCVSS802B		Environmental Remediation of Contaminated Sites								
BTCVSS802C		Remote Sensing Essentials								
BTCVSS802D		Mechanical Characterization of Bituminous Materials								
BTCVSS802E		Soil Structure Interaction								
BTCVSS802F		Design of Water Supply Systems								
BTCVP803	Project Stage-II	Project Stage II or Internship	--	--	24	100	--	100	200	12
		Total	04	--	24	140	40	220	400	18

[##] ***Student may take foreign language course from online platform NPTEL/SWAYAM/any other approved foreign language course run by university***

[#] ***The subjects are to be studied on self-study mode using SWAYAM/NPTEL/any other online source approved by the University.***

[**] ***If required Coordinator may be appointed for each Self-study course and an administrative load of 02 hours per week may be considered for monitoring and assisting the students, and to conduct examination (if required), evaluation and preparation of result.***

[$] ***If the examination schedule for the online Self study course chosen by student do not match with the University's Academic Schedule, University/Institute have to conduct exam for such courses.***

**** Internship of One Semester as per BTCEP803: One Faculty guide from the Institute side and one Mentor from the Industry should be identified to monitor the progress of work. During the period of Internship, a review of work should be taken followed by a final presentation at the end.***

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Final Year B Tech Civil Engg.

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTCVC701	**Core**	Design of Reinforced & Prestressed Concrete Structures	3	1	--	20	20	60	100	4
BTCVC702	**Core**	Infrastructure Engineering	3	--	--	20	20	60	100	3
BTCVC703	**Core**	Construction Techniques	3	--	--	20	20	60	100	3
BTCVC704	**Core**	Professional Practices	3	1	--	20	20	60	100	4
BTCVE705A	**Elective IV**	Engineering Economics	3	--	--	20	20	60	100	3
BTCVE705B		Finite Element Method								
BTCVE705C		Limit State Design of Steel Structures								
BTCVE705D		Rock Mechanics								
BTCVE705E		Applications of Drone Technology								
BTCVE705F		Advanced RC Design								
BTCVE705G		Applied Hydrology & Flood Control								
BTCVE705H		Legal Aspects in Civil Engineering Contracts								
BTCVE705I		Bridge Engineering								
BTCVOE706A	**Open Elective V**	Advanced Structural Analysis	3	--	--	-	--	--	--	Audit
BTCVOE706B		Air Pollution Control								
BTCVOE706C		Applications of AI and ML in Civil Engineering								
BTCVOE706D		Introduction to Earthquake Engineering								
BTCVOE706E		Internet of Things								
BTCVOE706F		Tunneling and Underground Excavations								
BTCVOE706G		Bamboo Construction Technology								
BTHM707A		Essence of Indian Traditional Knowledge	2	--	--	--	--	--	--	Audit
BTHM707B		Foreign language[##]								
BTCVL708	Lab.	Design & Drawing of Prestressed Concrete Structures	--	--	2	30	--	20	50	1

BTCVL709		Professional Practices	--	--	2	30	--	20	50	1
BTCVP610	Training	Field Training / Internship/Industrial **Evaluation**	--	--	--	--	--	50	50	1
BTCVS710	BTS	Seminar	--	--	2	--	--	50	50	1
BTCVP711	BTP	Project Stage-I**	--	--	4	--	50	50	100	3
		Total	**20**	**2**	**10**	**160**	**150**	**490**	**800**	**24**

Detailed Syllabus (VII Semester)

BTCVC701 Design of RC and PSC Structures

Teaching Scheme: (3 Lectures + 1 Tutorial) hours/week

Course Contents
Limit State Method for RC Structures

Module 1: **(6 Lectures)**
Limit State of Collapse (Torsion) - Types of torsion, behavior of R.C. rectangular sections subjected to torsion, Design of sections subjected to combined bending and Torsion

Module 2: **(6 Lectures)**
Analysis and design of axially and eccentrically loaded short columns (Circular and Rectangular), detailing of reinforcement, and construction of Interaction diagrams for uni-axial bending, concept of bi-axial bending Prestressed Concrete

Pre-stressed Concrete Structure

Module 3: **(8 Lectures)**
Introduction to prestressed concrete, concepts, types, systems and methods of pre stressing,

Module 4: **(10 Lectures)**
Stress analysis for rectangular and symmetrical I sections, Pressure Line, Cable Profiles
Losses in Prestressing for Pre-tensioned & Post tensioned members

Module 5: **(6 Lectures)**
Design of Rectangular and Symmetrical I sections, Design of End Block
Structural audit of various structures such as load bearing wall type, RCC, Steel Framed, Prestressed Concrete, etc.: conceptual introduction to elaborate necessity, implementation of audit, format of reporting, consequences

Text Books

1. IS: 456, IS 1343, SP16, SP24, SP34 of Recent Editions, Bureau of Indian Standards, New Delhi
2. Karve& Shah, “Limit State Theory & Design”, Structures Publications, Pune
3. Lin T.Y., “Prestressed Concrete”, John Willey & Sons New York
4. Jain A.K., “Reinforced Concrete Design (Limit State)”, Nemchand Brothers, Roorkee
5. Sinha S.N., “Reinforced Concrete Design”, Vol. I, II, Tata Mc-Graw Hill
6. Sinha& Roy, “Fundamentals of Reinforced Concrete”, S. Chand & Co. New Delhi
7. Sinha& Roy, “Prestressed Concrete”, S. Chand & Co. New Delhi
8. Krishnaraju N., “Prestressed Concrete”, Tata Mc-Graw Hill

Reference Books

1. Punmia B.C., “Reinforced Concrete Design”, Vol. I, II, Laxmi Publications
2. Varghese P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, New Delhi
3. Relevant Publications by Bureau of Indian Standards, New Delhi
4. Indian Standard codes related with nondestructive testing, Government Resolutions related to Structural Audits (BMC Act, etc.), Field manuals and reports by Expert Consultants.

Course Outcomes: On completion of the course, the students will be;

CO:1 Able to identify the behavior, analyze and design of the beam sections subjected to torsion.

CO:2 Able to analyze and design of axially and eccentrically loaded column and construct the interaction diagram for them.

CO:3 Understand various concepts, systems and losses in pre-stressing.

CO:4 Able to analyze and design the rectangular and symmetrical I-section pre-stressed beam/girders.

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BTCVC702 Infrastructure Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1 **(8 Lectures)**

Railway Engineering: Permanent Way, gauges, rails, sleepers, ballast, sub grade formation, fixtures and fastenings, Geometric Design of tracks- Horizontal Alignment, Vertical Alignment

Module 2 **(8 Lectures)**

Points and Crossings: Standard types, Design of simple turnout, various types of Junctions, Stations and Yards: Purpose, Location, Site selection, general layouts of Terminus and Junction, Signaling and Interlocking, Construction and Maintenance of Track, Modern trends in Railways

Metro Rail: Introduction to mass rapid transit system in India, Options of Mass Rapid Transit Systems(MRTS), Choice of Metro Rail as a Mode of Mass Transit, Advantages and disadvantages, Planning and Implementation of Metro Rail Projects, Private participation and public private partnership (PPP), Financing options of metro rail project in India, Alignment and track structure requirement, Track components- Rail, Rail to sleeper Fastenings, Base slab

Module 3: **(6 Lectures)**

Dock and Harbor Engineering: Inland Water Transport in India, Tides, Winds and Waves Erosion, Transport of Sediments, Beach Drift, Littoral Drift, Sand Bars, Coast Protection, Classification of Ports and Harbors, Site Selection, Features of Break Waters, Jetties, Wharves, Piers, Facilities required, Dry Docks, Wet Docks, Lift Docks, Floating Docks, Spillways, Navigational Aids, Lighthouses, Terminal Buildings, and Dredging- Special Equipment.

Module 4: **(6 Lectures)**

Airport Engineering: Planning, Airport Surveys, Site Selection, Zoning Laws, Runways, Geometric Design, Airport Capacity, Terminal Buildings, Parking Systems, Taxiways, Hangers, Airport Drainage, Air Traffic Control, Airport Lighting

Module 5: **(8 Lectures)**

Tunnel Engineering: Shape and Size of Tunnel Shafts, Pilot Tunnels, Tunneling in Hard Rock, Tunneling in Soft Materials, Drilling-Patterns, Blasting, Timbering, Mucking, Tunnel Lining, Advances In Tunneling Methods, Safety Measures, Ventilation, Lighting and Drainage of Tunnels

Text Books

1. Saxena S. C. and Arora S. (2003) “A Course in Railway Engineering,” Dhanpat Rai & Sons, Delhi
2. Arora N. L. (1995) “Transportation Engineering”, IPH New Delhi
3. Bindra S. P. “Bridge Tunnel and Railway Engineering”, Dhanpatrai and Sons, New Delhi
4. Hariharan K. V. (2002) “Multimodal Transport & Infrastructure Development in India”, Shroff Publishers, Mumbai
5. Quinn A. D. “Planning and Construction of Docks and Harbours”, Tata McGraw Hill, New Delhi
6. Oza H. P. and Oza G. H. (2012) “Dock and Harbour Engineering”, Chartor Publishing House, Anand
7. Shrinivasan R. (2016) “Dock, Harbour and Tunnel Engineering”, Chartor Publishing House, Anand
8. Khanna S. K. and Arora N. L. (1999), “Airport Engineering” Nemchand& Bros., Roorkee
9. Rangawala S. C. (2012) “Airport Engineering”, Charotar Publishing House Pvt. Limited, Anand

References

1. Publications of Bureau of Indian Standards, New Delhi, Relevant To the Syl Laboratories
2. Cormick H. F. (1975) “Dock and Harbour Engineering” Giffin Publishers
3. Horonjeff R. (2012) “Planning and Design of Airports”, Tata McGraw Hill, New Delhi

Course Outcomes: On completion of the course, the students will be able to:

CO:1 Know about the basics and design of various components of railway engineering

CO:2 Understand the types and functions of tracks, junctions and railway stations.

CO:3 Able to understand Airport engineering.

CO:4 Able to understand Docks and Harbours.

CO:5 Know about the aircraft characteristics, planning and components of airport

CO:6 Understand the types and components of docks and harbors

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BTCVC703 Construction Techniques

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(8 Lectures)**

Introduction, planning of a new project, site access and services, mechanical and manual construction, excavation in earth: Understanding basics and functions of equipment, earthmoving equipment - Tractors, Bulldozers, Scrappers, Power shovel, Hoes, simple numerical problems based on cycle time and production rates, drag line, Clamshell, Trenchers, Compactors- types and performance, operating efficiencies, lifting capacities

Module 2: **(6 Lectures)**

Excavation in hard rock, Rippers, jack hammers, drills, compressors and pneumatic equipment, blasting explosives, detonators, fuses, drainage in excavation – necessity and methods of dewatering

Module 3: **(6Lectures)**

RMC Plant, layout and production capacity, type of concrete mixers, machinery for vertical and horizontal transportation of concrete, grouting, Shotcreting, under water concreting, Type of formwork, Slip formwork, equipment for placing of concrete in normal and difficult situations

Module 4: **(6 Lectures)**

Prefabricated construction: Relative economy, steel construction: planning and field operations, erection equipment, cranes of various types such as tower, crawler, luffing jib tower crane, floating and dredging equipment

Module 5: **(8 Lectures)**

Road construction aspects, asphalt mixing and batching plant (Hot Mix Plant), sensor paver for rigid roads, crushing plants belt conveyers, cableway, construction of a new railway track, aspects of bridge construction

Diaphragm walls: purpose and construction methods, safety measures in construction, prevention of accidents and introduction to disaster management

Text Books

1. Peurifoy R.L. (2010). Construction, Planning, Equipment & Methods, McGraw hill Book Co. N. Delhi
2. Verma Mahesh, (1975). Construction Equipment, Metropolitan book Co., New York
3. Singh J., (2006). Heavy Construction - Planning, Equipment & Methods, Oxford & IBH Pub., N. Delhi

Reference Books

1. Quin A. (1961), Planning and Construction of Docks and Harbors, Mc-Graw Hill Company, New York.
2. Stubbs F. W., (1971). Hand Book of Heavy Construction, Mc-Graw Hill Inc, US 2nd edition.
3. Boyes R.G.H, (1975). Structural & cut off Diaphragm Walls, Applied Science Publishers Ltd. London.
4. Ataev S. S., (1999). Construction Technology, Mir Publishers, Mascow.

Course Outcomes: On completion of the course, the students will be able to:

CO:1 Understand the planning of new project with site accessibility and services required.

CO:2 Comprehend the various civil construction equipment's.

CO:3 Familiar with layout of RMC plant, production, capacity and operation process.

CO:4 Recognize various aspect of road construction, construction of diaphragm walls, railway track construction etc.

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BTCVC704 Professional Practices

Teaching Scheme :(3 Lectures + 1 Tutorial) hours/week

Course Contents

Module 1: Introduction of Estimate **(8 Lectures)**

Introduction to estimating, purpose, types, items of inclusion, modes of measurement for different works, administrative approval and technical sanction to estimates; Quantity Surveying: Specifications: purpose general and detailed specifications for various

items of work, prime cost, provisional sums and provisional quantities, taking out quantity, P.W.D. method, recording of measurements

Module 2: Costing **(8 Lectures)**

Analysis of rates for various items of construction of civil engineering works, standard schedule of rate, price escalation, detailed and approximate estimates for buildings, R.C.C works, culverts, earthwork for canals, roads including hill roads and other civil engineering works

Module 3: Tendering **(8 Lectures)**

Types, preparation of tender papers, conditions of contracts, competitive bidding, types of bids, invitation of tenders, scrutiny and acceptance of tenders, award of jobs, introduction to B.O.T. and similar other basis of execution,

Module 4: Contracts **(6 Lectures)**

Essentials of legally valid contract, types and forms of contract between various agencies, organizational set up of P.W.D. classification of works, method of carrying out work in P.W.D. mode of payment, bill forms, introduction to arbitration

Module 5: Valuation **(6 Lectures)**

Principles, types, price and cost, attributes of value, valuer and his duties, factors affecting the valuation of properties, methods of valuation, different types of lease

Valuation from yield and from life, gross yield and net yield, sinking fund, depreciation, different methods of calculating depreciation, depreciated cost, obsolescence

Text Books

1. Dutta B. N. (2012) "Estimating and Costing", UBS Publishers Distributors, New Delhi
2. Namavati R. H. (2016) "Professional Practice Estimating and Valuation", Lakhani book Depot, Mumbai
3. Patil B. S. (2015) "Civil Engineering Contracts and Estimates", Universities Press, Hyderabad
4. Bhasin P. L. (1987) "Quantity Surveying", S. Chand & Co. Ltd., Mumbai
5. Rangwala S. C. (1990), "Elements of Estimating and Costing", Charotar Publication, Anand
6. Birdi G. S. (2014) "Estimating and Costing", DhanpatRai& Sons, N. Delhi
7. Chakroborty M. (2010) "Estimating, Costing & Specification in Civil Engineering", M.Chakraborty Publication, Nepal
8. Rangwala S. C. (2011) "Valuation of real Properties", Charotar Publication, Anand

References

1. Govt. of Maharashtra P.W. and Housing Department Publication edition 1979 and 1981
2. P. W. D. Maharashtra, "Standard Specifications", Volumes I & II
3. C.P.W.D. Specifications
4. C.P.W.D. Schedule of Rates
5. P.W.D. Maharashtra Schedule of Rates
6. Publications of Bureau of Indian Standards: IS 1200 all parts, and other relevant

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand the importance of preparing the types of estimates under different conditions for various structures.

CO2: Know about the rate analysis and bill preparations and to study about the specification writing.

CO3: Know the various types of contract, accounts in PWD, methods for initiating the works in PWD and tendering.

CO4: Understand the valuation of land and buildings, various methods and factors affecting valuation.

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BTCVE705A Engineering Economics

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1 **(06 Lectures)**

Introduction to engineering economics, importance, demand and supply, types of costs, types of interests, value of money – time and equivalence, tangible and intangible factors, introduction to inflation,

Module 2 **(06 Lectures)**

Cash Flow diagram, Nominal and effective interest – continuous interest, Single Payment Compound Amount Factor, Uniform series of Payments, comparing alternatives, Present worth Analysis, Annual worth Analysis, Future worth Analysis, Rate of Return Analysis, Break Even Analysis, Benefit/Cost Analysis

Module 3 **(06 Lectures)**

Economics of Project Parameters, Equipment Economics, Operating Costs, Buy, Rent and Lease Options, |Replacement Analysis, Cost Estimates, Type of Estimates, Parametric Estimate, Management Accounting, Financial accounting principles, basic concepts, Financial statements, accounting ratios

Module 4 **(08 Lectures)**

Investment Evaluation and Financing Projects, Taxation, Depreciation, switching between different depreciation methods, Inflation, Sources of finance, equity, debit, securities, borrowings, debentures, Working capital requirement, financial institutes

Module 5 **(08 Lectures)**

Financial Management, Introduction, Charts of Accounts, Balance Sheet, Financial Ratios, Working Capital Management, Budgeting and budgetary control, Performance budgeting. Profit & Loss, statement, Ratio analysis, Appraisal through financial statements, International finance forward

Text Books

1. Blank, L.T., and Tarquin, A. J., (1988). Engineering Economy, Mc-Graw Hill Book Co.
2. Collier C. and GlaGola C. (1998). Engineering Economics & Cost Analysis, Addison Wesley Education

Publishers,

3. Patel, B. M., (2000). Project management- strategic Financial Planning, Evaluation and Control,Vikas Publishing House Pvt. Ltd. New Delhi,
4. Shrivastava, U. K., (2000). Construction Planning and Management, Galgotia Publications Pvt. Ltd. New Delhi.

References

1. Van Horne, J.C. (1990). Financial Management and Policy, Prentice-Hall of India Ltd.
2. Taylor, G.A. (1968). Managerial and Engineering Economy. East-West Edition.
3. Thuesen, H.G. (1959). Engineering Economy, Prentice-Hall, Inc.
4. Brigham, E.F. (1978). Fundamentals of Financial Management, the Dryden Press, Hinsdale, Illinios,
5. Kolb, R.W. and Rodriguez, R.J. (1992). Financial Management, D.C. Heath & Co.
6. Walker, E.W. (1974). Essentials of Financial Management, Prentice Hall of India Private Limited, New Delhi.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Adopt as per principles of economics and financing

CO2: Analyze available alternatives and propose best suitable among them

CO3: Apply various models of financial management and accounting

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BTCVE705B Finite Element Method

Teaching Scheme: (3Lectures) hours/week

Course Contents

Module 1: Introduction to FEM & Approximate Methods **(06 Lectures)**

Introduction, Overview of Various Methods to Solve Integral & Differential Equations (Point Collocation Method, Method of Least Square, Weighted Residual Method, Galerkin's Method), Variational Calculus (Hamilton's Variational Principle, Minimum Potential Energy Principle, Euler Lagrange Equation), Partial FEM (Kentorvich Method/ Finite Strip Method/ Semi-Analytical Method), Local & Global Finite Element Methods (Rayleigh-Ritz Method), Stepwise Procedure.

Module 2: One Dimensional FE Analysis **(06 Lectures)**

Application of FEM to Solve various 1-D problems (Shape Functions for 1-D Elements, Properties of Shape Functions, Lagrange Interpolating Polynomials), C0 Continuity, 1-D FE Analysis (Discretization, Selection of Shape Function, Defining Gradients of Primary Unknowns & Constitutive Equations, Derivation of Element Equations, Assembly & Application of Boundary Conditions, Computation of Primary and Secondary Unknowns), Direct Approach for Assembly, Boundary Conditions (Geometric, Natural), Concept of Sub-Structuring (Static Condensation), Stiffness Matrix for Basic Bar & Beam Element, Representation of Distributed Loading, The Assembly Process within the PMPE Approach, Element Stresses)

Module 3: FE Analysis by Direct Approach **(06 Lectures)**

C1 Continuity, Formulation of 1-D Beam Element, Classical Beam Theory, Element Equation Formulation (Galerkin's Approach, Rayleigh-Ritz Approach), Derivation of Scalar Functional from Differential Equation and Vice Versa, Simple applications to Beams.

Module 4: Two Dimensional FE Analysis **(06 Lectures)**

Conditions of Symmetry & Anti Symmetry (Applications), 2-D FE Analysis, Review of Theory of Elasticity, CST Element (3-Node Triangular Element), Pascal's Triangle and Pyramid, Area Co-ordinate, Stepwise Formulation, Equivalent Load Vector, Plane Stress Problems using CST Elements, 2-D Stress Analysis using 4-noded Rectangular Element, Stepwise Formulation, Effect of Aspect Ratio, Explicit & Implicit Iso-parametric Formulation, Iso-parametric Elements for Plane Problems

Module 5: Three Dimensional FE Analysis **(04 Lectures)**

3-D Stress Analysis using FEM, Iso-parametric Formulation, 3-D Brick Element, FEA of Axi-symmetric Solids Subjected to Axi-symmetric and Asymmetric Loads (all contents at introductory level)
Computer Implementation of FEM, Application of FEM to Time Dependent Problems, Partial FEM, h-version of FEM, p-version of FEM, Adaptive Meshing, Exposure to Hybrid FEM (Mixed/ Hybrid Formulation, Unidirectional Composites), Introduction to software's, elementary problem-solving using freeware

References:

1. Mukhopdhyay, M., (1984). Concept and Application of Finite Element Analysis, Oxford and IBH Publishing Co. Pvt. Ltd.
2. Zienkiewicz, O.C and Taylor R.L., (2000). The Finite Element Method, Vol 1 & 2; 5th Ed, Butterworth- Heinemann,
3. Reddy J. N. (2005). An Introduction to Finite Element Method, McGraw Hill , 3rd Ed,
4. Cook R.D., Malcus D.S. and Plesha, (1997). Concepts and Applications of Finite Element Analysis,4th Ed, Wiley.
5. Hutton D.V., (2004). Fundamentals of Finite Element Analysis, Tata McGraw Hill Pub.
6. Desai C. S. & Abel J. F., (1974). Introduction to the Finite Element Method, CBS Pub.
7. Krishnamoorthy C. S, (1994). Programming in the Finite Element Method, Tata McGraw Hill.
8. Chandrupatla T. R. and Belegundu,(2002). Introduction to the Finite Element in Engineering, Pearson Education.
9. Bathe K.J., (1996). Finite Element Procedures, PHI learning pvt.ltd
10. Desai Y.M., and Eldho T.I, (2011). Finite Element Method with application in Engineering, Pearson, Delhi
11. Bhavikatti S. S. (2015). Finite Element Analysis, New Age International Publication.

Course Outcomes: Upon completion of the course the students will be able to:

CO1: Understand the different energy methods in structural analysis and basic concepts of finite element method.
CO2: Analyze 1-D problems related to structural analysis like Bars, Trusses, Beams and Frames using finite element approach.
CO3: Find solution to problems using direct approach methods like Rayleigh – Ritz or Galerkin's Method.
CO4: Solve 2-D problems using knowledge of theory of elasticity.
CO5: Students will be able to implement the knowledge of numerical methods in FEM to find the solution to the various problems in statics and dynamics.

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BTCVE705C Limit State Design of Steel Structures

Teaching Scheme: (3Lectures) hours/week

Course Contents

Module 1: Introduction **(4 Lectures)**
Introduction, advantages & disadvantages of steel structures, permissible stresses, factor of safety, methods of design, types of connections, various types of standard rolled sections, types of loads and load combinations

Module 2: Connections **(4 Lectures)**
Types: Riveted, Bolted, Welded; Analysis of axially & eccentrically loaded connections (subjected to bending & torsion), Permissible Stresses, Design of connections, failure of joints

Module 3: **Axially Loaded Members** **(6 Lectures)**
Tension members: Common sections, net effective area, load capacity, connection using weld / bolts, design of tension splice
Compression members: Common sections used, effective length and slenderness ratio, permissible stresses, load carrying capacity, connection using weld / bolt

Module 4: Beams **(6 Lectures)**
Laterally supported & unsupported beams, design of simple beams, built up beams using flange plates, curtailment of flange plates, web buckling & web crippling, secondary and main beam arrangement, beam to beam connections

Module 5: Industrial Roofing **(6 Lectures)**
Gantry girder: Forces acting on a gantry girder, commonly used sections, introduction to design of gantry girder as laterally unsupported beam, connection details
Roof trusses: Components of an industrial shed, types of trusses, load calculations and combinations, design of purlins, design of truss members, design of hinge & roller supports

Note: Contents in Module 1 to part of 5 shall be taught with help of relevant text or reference books based on elastic **design concept and shall be taught with reference to IS 800 2007**

Use of IS 800: 1984 and 2007, IS 875 (All Parts), IS: Handbook No.1 for Steel Section and Steel Table is permitted for theory examination.

Text Books

1. Duggal S. K. (2017) "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
2. Gambhir M. L. (2017) "Fundamentals of Structural Steel Design", Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Negi L. S. (2017) "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
4. Chandra Ram (2016) "Design of Steel Structures", Vol. I & Vol. II, Standard Book House, New Delhi
5. Subramanian N. (2010) "Steel Structures: Design and Practice" Oxford Univ. Press, Delhi
6. Sai Ram K. S. (2015) "Design of Steel Structures", Pearson Education, Delhi

Reference Books

1. Arya A. S. and Ajamani J.L. (2014) "Design of Steel Structures", Nemchand and Brothers, Roorkee
2. Vazirani V.N. and Ratwani M.M. (1988) "Design of Steel Structures", Standard Book House, New Delhi
3. Publications of Bureau of Indian Standards, New Delhi, IS 800:1984, 2007, IS 875 (Part I to V)
4. Gaylord E.H. and Gaylord C.N. (1991) "Design of Steel Structures" McGraw Hill, New York
5. Salmon C. G. and Johnson J. E. (2008) "Steel Structures: Design and Behaviour", Harper and Row, New York
6. Steel Designers Manual.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify and compute the design loads and the stresses developed in the steel member.
CO2: Analyze and design the various connections and identify the potential failure modes.
CO3: Analyze and design various tension, compression and flexural members.
CO4: Understand provisions in relevant BIS Codes.

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BTCVE705D Rock Mechanics

Teaching Scheme: (3Lectures) hours/week

Course Contents

Module 1: Introduction **(Lectures 08)**

Introduction, Development, Objective, and Scope of Rock Mechanics, Applications of Rock Mechanics: Slopes, Underground Excavations, Foundations, and Rock Support Systems. Physical and Mechanical Properties of Rocks, Factors Affecting the Strength and Deformation of Rocks, Lineaments, Discontinuities in Rocks, and Associated Problems.

Module 2: Rock Testing **(Lectures 08)**

Introduction; Rock Sampling, Laboratory Testing, and In-Situ Determination of Strength of Rock Samples and identifying its Properties like Density, Porosity, and Water Absorption, Using Methods like Uniaxial Compressive Strength, Tri-Axial Compressive Test, Tensile Strength, Shear Strength, Flexural Strength, Swelling and Slake Durability, Permeability, and Point Load Strength.

Module 3: Engineering Classification Rock Mass **(Lectures 08)**

Concept of Rock Mass, Geological Strength Index, Rock Quality Designation, Classification systems, Rock Mass Rating, Rock Structure Rating, Deere and Miller classification, Geo-mechanics and NGI Classification Systems, and Applications in Civil Engineering Projects.

Module 4: Rock Mass Behavior at Slope **(Lectures 06)**

Stability of Rock Slopes, Modes of Failure, Methods of Analysis, Prevention, and Control of Rock Slope Failure, and Slope Monitoring Techniques.

Module 5: Strength Criteria and Improvement Techniques of Rock Mass **(Lectures 06)**

Mohr-Coulomb criterion, Hoek and Brown criterion, Barton's Theory of Rock Mass Stability, Methods of Improving Rock Properties, Rock Reinforcement & Rock Bolting: Rock Bolts, Rock Anchors, Steel Mats, Precast Concrete Segments, Shotcrete, and Grouting, etc.

Text Books

1. Ramamurthy, T (2007). "Engineering in Rocks for Slopes, Foundation, and Tunnels." N. Delhi, PHI Pvt. Ltd.
2. Singh, B and Goel RK (2011). "Engineering Rock Mass Classification" Oxford, UK, Elsevier Inc.
3. Sivakugan, N, Shukla, SK and Das, BM (2013). "Rock Mechanics: an introduction". Boca Raton, FL, CRC Press.

Reference Book

1. Goodman R. E., "Introduction to Rock Mechanics", John Wiley and Sons, India
2. Obert and Duvall, "Rock Mechanics and Hydraulic Structures", John Wiley and Sons, India
3. Winterkorn and Fang, "Foundation Engineering Hand Book" Springer, Boston, MA.
4. Relevant Indian Standards.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand about rock mechanics and its applications.

CO2: Able to determine the engineering properties of rocks and sub-surface conditions.

CO3: Identify various causes of slope failure and suggest some preventive measures for them.

CO4: Categorize rock mass into various classes for recognizing overall rock mass quality.

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BTCVPE705E Applications of Drone Technology

Teaching Scheme: (3Lectures) hours/week

Course Contents

Module 1: Introduction to Drone Technology (6 Lectures)

Overview of drone technology and its versatility, Importance of drones in civil engineering projects,, Understanding the role of data in drone applications, Examples of successful drone applications in civil engineering, Introduction to different types of drones and their capabilities, Brief introduction to relevant drone regulations and certifications

Module 2: Drone Data Acquisition (8 Lectures)

Comparison of drones with traditional surveying and inspection methods.Flight planning fundamentals for civil engineering projects, Understanding the importance of mission objectives and data requirements, Factors influencing drone flight, such as weather conditions and airspace restrictions,, Introduction to LiDAR (Light Detection and Ranging) technology and its applications, Data acquisition for various civil engineering projects, including surveying, construction, Water Management and infrastructure inspection, Safety precautions and emergency procedures during drone operations.

Module 3: Drone Application in Civil Engineering (8 Lectures)

Overview of drone applications in civil engineering disciplines, including surveying, construction, inspection, and environmental monitoring, Importance of drones in enhancing efficiency and accuracy in civil engineering projects, Benefits and limitations of using drones in civil engineering projects, Construction site management using drones: Progress monitoring, material tracking, and site safety assessment.

Module 4: Drone Data Processing and Analysis (6 Lectures)

Data processing software and tools, 3D modeling and point cloud analysis, GIS integration and mapping, Data interpretation and visualization, Emerging trends in drone technology, Discussion on drone payload options for various data collection needs, Case studies illustrating the economic and environmental advantages of using drones in civil engineering projects

Module 5: Advanced Topics in Drone Technology (8 Lectures)

Drones in transportation engineering: Road and highway planning and monitoring, Surveying and mapping with drones: Topographic mapping and contour generation, Infrastructure inspection and monitoring with drones: Bridges, buildings, dams, and roads, Drones in water resources engineering: Flood modeling and hydrological monitoring, Drones in flood mapping, forest monitoring and post-disaster damage assessment.

Text Books

1. Randal W. Beard and Timothy W. McLain: Small Unmanned Aircraft
2. Theory and Practice, Princeton University Press, 2012
3. Kimon P. Valavanis: Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Springer, 2007

Reference Books

1. Drone Technology in Architecture, Engineering, and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation by Daniel Tal and Jon Altschuld, 2021
2. Drones: Technology and Business Plan for Civil Engineering by Thiago Prudêncio and Gleydson Carlos Almeida, 2023
3. Small Unmanned Aircraft Systems Guide: Exploring Designs, Operations, Regulations, and Economics by Brent Terwilliger, 2017

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand about drone technology and its applications.
CO2: Able to understand drone data acquisition techniques.
CO3: Able to understand application of drone in Civil Engineering Project.
CO4: To analyze different drone data processing software and tools.
CO5: To understand different advanced methods used in drone technology.

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BTCVPE705F Advanced RC Design

Teaching scheme: (3 Lectures) hour/week

Course Contents

Module 1: Circular Slabs **(10 Lectures)**

Introduction, Slabs freely supported at edges and carrying UDL, Slabs fixed at edges and carrying UDL, , Slabs simply supported at the edges with load UDL w Uniformly distributed along the circumference of a concentric circle, Slab simply supported at edges with UDL inside a concentric circle, Slab simply supported at edges with a central hole and carrying UDL Slab simply supported at edges with a central hole and carrying w Uniformly distributed along the circumference of a concentric circle.

Module 2: Flat Slabs **(10 Lectures)**

Introduction, Components of Flat Slab Construction, IS Code Recommendations (IS: 456-2000), Direct Design Method, Equivalent Frame Method, Shear in Flat Slab, Slab Reinforcement, Openings in Flat Slab.

Module 3: Domes **(5 Lectures)**

Introduction, Nature of Stresses in Spherical Domes, Analysis of Spherical Domes, Stresses due to Wind load, Design of RC Domes, Conical Domes.

Module 4: Bunkers and Silos **(5 Lectures)**

Introduction, Janssen's theory, Airy's theory ,Bunkers, Hopper Bottom, Indian Standard on Design of Bins(IS :4995-1968)

Module 5: Chimneys **(6Lectures)**

Introduction, wind pressure, stresses in chimney shaft due to self weight and wind, stresses in horizontal reinforcement due to wind shear, stresses due to Temperature difference ,combined effect of self load ,wind and temperature, temperature stresses in horizontal reinforcement, Design of RC Chimneys.

Text Books

1. IS: 456, IS 1343, SP16, SP24, SP34 of Recent Editions, Bureau of Indian Standards, New Delhi
2. Karve & Shah, "Limit State Theory & Design", Structures Publications, Pune
3. Lin T.Y., "Prestressed Concrete", John Willey & Sons New York
4. Jain A.K., "Reinforced Concrete Design (Limit State)", Nemchand Brothers, Roorkee.
5. Sinha S.N., "Reinforced Concrete Design", Vol. I, II, Tata Mc-Graw Hill
6. Sinha& Roy, "Fundamentals of Reinforced Concrete", S. Chand & Co. New Delhi
7. Sinha& Roy, "Prestressed Concrete", S. Chand & Co. New Delhi
8. Krishnaraju N., "Prestressed Concrete", Tata Mc-Graw Hill

Reference Books:

1. Punmia B.C., "Reinforced Concrete Design", Vol. I, II, Laxmi Publications
2. Varghese P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, New Delhi
3. Relevant Publications by Bureau of Indian Standards, New Delhi
4. Indian Standard codes related with nondestructive testing, Government Resolutions related to Structural Audits (BMC Act, etc.), Field manuals and reports by Expert Consultants.

Course Outcomes: On completion of the course, the students will be;

1. Able to identify the behavior, analyze and design of circular slabs, flat slab.
2. Able to analyze design domes, bunkers and silos and Chimneys.

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BTCVPE705G Applied Hydrology and Flood Control

Teaching scheme: (3 Lectures) hour/week

Course Contents

Module 1: (6 Lectures)

Precipitation: Types of precipitation, measurement, Presentation of rainfall data mass rainfall curves, Hyetograph, Concepts of depth area duration analysis, Frequency analysis frequency of point rainfall and plotting position, Intensity duration curves, Maximum Intensity duration frequency analysis.

Module 2: (6 Lectures)

Runoff, Introduction, Factors affecting runoff, Rainfall Runoff relationships, Empirical Techniques to determine runoff, Runoff hydrograph Introduction, Factors affecting Flood Hydrograph, Components of Hydrograph, Base flow separation, Effective rainfall, Unit hydrograph theory, S curve hydrograph, uses and limitations of Unit Hydrograph

Module 3: (6 Lectures)

Floods: Types of floods, Estimation of peak flow, Rational formula and other methods, Flood frequency analysis, Gumbel's method, Design floods.

Module 4: (6 Lectures)

Flood Estimation and Routing: Estimation of design flood, SPF/MPF empirical methods, Statistical methods, Frequency analysis, Unit hydrograph method, Flood estimation in small watersheds and mountainous region, Estimation by lumped, distributed model, Routing, Lumped, Distributed, Hydraulic and hydrological routing.

Module 5: (6 Lectures)

Flood Control and Management: Flood routing, Hydrological channel routing by Muskingham method, Hydrologic reservoir routing. Flood control methods, Structural and non-structural measures Flood plain Zoning, Flood disaster monitoring and mitigation procedure, Methods of forecasting, Data analysis and warning, Flood fighting Remote Sensing for flood management.

Text books:

1. Das G., Hydrology and Soil Conservation Engineering 2nd Edition. Prentice Hall of India Pvt. Ltd. New Delhi. 2009.
2. Subramanya K., Engineering Hydrology, Tata McGraw-Hill Book Co., New Delhi. 1984.
3. Chow V.T., Maidment D.R., and Mays L.W., Applied Hydrology, McGraw Hill, 1998.
4. Applied Hydrology by K.N. Mutreja, Tata Mc-Graw Hill Book Co., New Delhi. 1985.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand the hydrologic extremes of floods.

CO2: Estimate severity and extent of damages and mitigation measures to combat them.

CO3: Understand the climate system, being aware of the impact of climate change on society.

CO4: Understand role of hydrological cycle precipitation and runoff in civil engineering systems.

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BTCVPE705H Legal Aspects in Civil Engineering Contracts

Teaching scheme: (3 Lectures) hour/week

Course Contents

Module 1: **(08 Lectures)**

Professional Practice and Administration Contracts: The standard form of building contracts, Indian contract Act, The right of building owner, Right of Contractor, Types of Civil Engineering contracts, RERA

Module 2: **(08 Lectures)**

Bailment: Nature of Transactions, Delivery of Bailee, care to be taken, Bailee's Responsibility, Termination, Bailment of pledges. **Injunction:** Types Temporary, Perpetual, Mandatory when referred, Indemnity and Guarantee: Difference between the two, The Contract of Guarantee and Indemnity,

Module 3: **(06 Lectures)**

Industrial Acts and Labour Laws: Indian factories Act, Industrial Dispute Act, Payment of Wages Act, Work Compensation Act, Trade Union Act, The Building and Other Constructions Workers' (Regulation of Employment and Conditions of Service) Act, 1996

Module 4: **(06 Lectures)**

Arbitration and Award: Indian Arbitration Act, Arbitration Agreement, Conduct of Arbitration, Power and Duties of Arbitration, Rules of Evidence, E- Tendering, Preparation and publication of ward, Methods of Enforcement impending and Awards.

Module 5: **(08 Lectures)**

Safety Engineering: Sources, Classification, Cost of Accident and Injury Workmen's Compensation Act, Safety Programme, Safety Organization. Employers Liability Act, Employers Insurance Act, Safety and Health Standards Occupations Hazards, personal Protective equipments, preventive measures Factory Act, Fatal accidents

Course Outcome (CO):

CO1: Students will learn Indian contract act, Arbitration act and contract administration
CO1: Student will gain knowledge about bailment and FIDIC
CO1: Students will understand the labour laws
CO1: Students will be exposed to safety engineering and relevant act

Text Books

1. Indian arbitration Act by B. S. Patil
2. Indian Contract Act.
3. Safety Engineering, Govt. of India Publication
4. Professional Practice, Roshan Namavati.
5. Legal Aspects of building and Engineering Contracts by B. S. Patil

Reference Books

1. Indian Contract Act Avatar singh
2. Indian contract Act Jhamb

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BTCVPE705I Bridge Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(6 Lectures)**

History of bridges, components and definitions, classification of road bridges, span length, classicalexamples of each type, people involved in the total process, history of analysis

Module 2: Selection of site and initial decision process **(8 Lectures)**

Survey and alignment, geotechnical investigations and interpretations River Bridge: Selection of bridge site and planning, collection of bridge design data, hydrological calculation, waterway calculation, scour calculation, depth of foundation, freeboard. Road Bridge: Selection of bridge site and planning, collection of bridge design data, vertical clearance.

Module 3: Standard loading for bridge design as per different codes **(6 Lectures)**

Road Bridges: IRC, BS code, AASHTO code. dead load, live load, impact factor, centrifugal force, windloads, hydraulic forces, longitudinal forces, seismic forces, earth pressure, buoyancy, lane concept,equivalent loads, traffic load, width of roadway and footway, use of influence lines for maximum forces in members, transverse distribution of live loads among deck longitudinal, load combinations for different working state and limit state designs.

Railway Bridges: Loadings for railway bridges, rail road data, pre-design considerations, rail road v/shighway bridges.

Module 4: Superstructures **(8 Lectures)**

Selection of main bridge parameters, design methodologies, choices of superstructure types:orthotropic plate theory, load distribution techniques, grillage analysis, finite element analysis(Preferable), different types of superstructures (RCC and PSC), Longitudinal analysis of bridge, slab bridge and voided slab bridge, beam-slab bridge, box girder bridge

Different types of bridge bearings and expansion joints, Design of bearings and joints.
Parapets for highway bridges: Definitions, classification of bridge parapets, various details

Module 5: Substructure **(6 Lectures)**

Pier, abutment, wing walls, importance of soil structure interaction
Foundations: open foundation, pile foundation, well foundation, examples - simply supported bridge,continuous bridge.

Text/Reference Books

1. Victor D. J., Essentials of Bridge Engineering, Oxford & IBH.
2. Raju N. K., Design of Bridges, Oxford & IBH.
3. Ponnuswamy S., Bridge Engineering, Tata McGraw Hill
4. Raina V K, “Handbook for Concrete Bridges” Vol. 1 and 2, Shroff Publishers, Mumbai
5. Raina V. K., Concrete Bridge Practice, (Analysis, Design Economics), 4th Edition, Shroff Publishers, Mumbai
6. Raina V. K., Concrete Bridge Practice, (Construction, Maintenance, Rehabilitation), 2nd Ed., Shroff Publishers, Mumbai.
7. Raina V. K., Field Manual for Highway and Bridge Engineers”, 3rd Edition, Shroff Publishers, Mumbai
8. Raina V. K., “World of Bridges”, Shroff Publishers, Mumbai

Course Outcomes: On completion of the course, the students will be able to:

1. Understand components of bridges and its various types.
2. Understand site selection criteria and comprehend various forces acting on bridges.
3. Analyze bridge structures using different analysis techniques.
4. Understand the importance of different types of bridge bearings.

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BTCVOE706A Advanced Structural Analysis

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Review of basic concepts in structural analysis **(06 Lectures)**

Type of structure, loads, response, statically determinate structures, principle of virtual work and displacement-based and force-based energy principles deriving stiffness and flexibility coefficients, Force method, Displacement Methods

Module 2: Matrix concepts and Matrix analysis of structures **(06 Lectures)**

Matrix; vector; basic matrix operations; rank; solution of linear simultaneous equations; eigenvalues andeigen vectors. Introduction; coordinate systems; displacement and force transformation matrices; Contra-gradient principle; element and structure stiffness matrices; Element and structure flexibility matrices; equivalent joint loads; stiffness and flexibility approaches

Module 3: Matrix analysis of structures with axial elements: **(08 Lectures)**

Introduction: Axial stiffness and flexibility; stiffness matrices for an axial element (two dof), plane truss element (four dof) and space truss element (six dof);One-dimensional axial structures: Analysis by conventional stiffness method (two dof per element) and reduced element stiffness method(single dof); Analysis by flexibility method;

Plane trusses: Analysis by conventional stiffness, method (four dof per element) and reduced element stiffness method (single dof); Analysis by flexibility method;

Space trusses: Analysis by conventional stiffness method (six dof per element) and reduced element stiffness method (single dof).

Module 4: Matrix analysis of beams and grids **(10 Lectures)**

Conventional stiffness method for beams: Beam element stiffness (four dof); generation of stiffness matrix for continuous beam; dealing with internal hinges, hinged and guided-fixed end supports; accounting for shear deformations;

Reduced stiffness method for beams: Beam element stiffness (two dof); dealing with moment releases, hinged and guided-fixed end supports;

Flexibility method for fixed and continuous beams: Force transformation matrix; element flexibility matrix; solution procedure (including support movements); Stiffness method for grids: Introduction; torsional stiffness of grid element and advantage of torsion release; analysis by conventional stiffness method using grid element with six dof; analysis by reduced stiffness method (three dof per element);

Module 5: Matrix analysis of plane frames: **(06 Lectures)**

Conventional stiffness method for plane frames: Element stiffness (six dof); generation of structure stiffness matrix and solution procedure; dealing with internal hinges and various end conditions;

Reduced stiffness method for plane frames: Element stiffness (three dof); ignoring axial deformations; dealing with moment releases, hinged and guided fixed end supports;

Flexibility method for plane frames: Force transformation matrix; element flexibility matrix; solution procedure(including support movements);Ignoring axial deformations;

References

1. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
2. Asslam Kassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
3. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
4. DevdasMenon, "Structural Analysis", Narosa Publishing House, 2008

Course Outcomes: On successful completion of this course the students will be able

CO1: To analyse the indeterminate structures by force and displacement methods of analysis.

CO2: To understand the fundamental concepts of the matrix for analysis of structures.

CO3: To analyse the one-dimensional axial structures by matrix approach.

CO4: To analyse the beams and grid structures by matrix approach.

CO5: To analyse the plane frames by matrix approach

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BTCVOE706B Air Pollution Control

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction to Air Pollution **(06 Lectures)**

The Structure of the atmosphere, Composition of dry ambient air and properties of air. BIS Definition and scope of Air Pollution, Scales of air pollution, Types of exposures. Air Pollutants,

Module 1: Classification **(08 Lectures)**

Classifications, Natural and Artificial, Primary and Secondary, point and Non-Point, Line and Area Sources of air pollution. Stationary and mobile sources, composition of particulate& gaseous pollutant, units of measurement. Effect of different air pollutants on man, animals, vegetation, property, aesthetic value and visibility, air pollution episodes. Global effects of air pollution- global warming, ozone depletion, acid rain and heat island effect.

Module3: Meteorology and Air pollution **(08 Lectures)**

Solar radiation, wind circulation, factors affecting dispersion of pollutants, Lapse rate, stability conditions, wind velocity profile, Maximum mixing depth (MMD), visibility, Wind rose diagram, General characteristics of stack plume (Plume behaviour). Gaussion diffusion model for finding ground level concentration. Plume rise. Formulae for stack height and determination of minimum stack height.

Module4: Air Sampling and Analysis (06 Lectures)

Air pollution survey, basis and statistical considerations of sampling sites. Devices and methods used for sampling gases and particulates. Stack emission monitoring, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Ambient air quality monitoring.

Module5: Photochemical Smog, Odour Pollution & Indoor Pollution (08 Lectures)

Chemistry of air pollution, Chain reactions of hydrocarbons, nitrogen oxide, Sulphuric oxides and intermediates, photochemical smog formation, air pollution indices -aerosols, fog, smog index. Odour pollution: Theory, sources, measurement and methods of control of odour pollution. Indoor air pollution: Causes of air pollution, sources and effects of indoor air pollutants, changes in indoor air quality, control of indoor air pollutants and air cleaning systems.

Text Books

1. Wark K. and Warner C. F. (1997) "Air pollution: Its Origin and Control" Pearson Education, Delhi
2. Rao M. and Rao H. V. N. (2017) "Air Pollution" Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Peavy S. H. and Rowe D. R. (2017) "Environmental Engineering" Tata McGraw Hill Pub. Co. Ltd., New Delhi
4. Muralio Krishna K. V. S. G. (2017) "Air Pollution and Control" Jain Brothers, Mumbai

Reference Books

1. Crawford M. (1984) "Air pollution Control Theory" McGraw Hill, New York
2. Anjaneyulu Y. (2002) "Air Pollution and Control Technologies" Allied Publishers, Mumbai
3. Raju B. S. N. (2018) "Fundamentals of Air Pollution" CBS Publishers and Distributors Pvt. Ltd., N. Delhi

Course Outcomes: On successful completion of this course the students will be able to

1. Identify the sources of air pollutants and their effect on human, plants and materials.
2. Apply knowledge of meteorology for controlling air pollution
3. Design air pollution controlling equipment.
4. Apply knowledge of legislation for prevention and control of air pollution.

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BTCVOE706C Applications of AI and ML in Civil Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction to AI and ML in civil Engineering (5 Lectures)

Understanding the fundamentals of AI and ML, Overview of AI techniques and Algorithms, AI and ML applications in Civil Engineering, Modeling concept

Module 2: AI and ML Techniques (8 Lectures)

Artificial Neural Networks, Machine Learning Algorithm, Neural Language Processing, Concurrent Neural Networks, Linear regression, Descriptive statics- Data exploration (histograms, scatter Plot etc), measure of central tendency, positions, dispersion and other measures, statistical analysis- measure of distribution (Skewness and Kurtosis), relation between attributes and other statistical graphs, data management- data acquisition, data pre processing and preparation, data quality and transformation.

Module 3: AI and ML in Transportation Engineering and Construction Planning (6 Lectures)

AI applications in Traffic flow optimization and analysis, intelligent transportation systems and traffic control, real time traffic prediction using ML Algorithms

Resource allocation and optimization in construction projects, Implementing AI based construction planning tools

Module 4: AI and ML in Water Resource Engineering and Environment Engineering (7 Lectures)

Model application in Water Resource Engineering- Classification, prediction and forecasting: time series data, Fuzzy model application in Water Resources Engineering: Runoff Hydrograph Simulation, Hydrograph Simulation at watershed scale, Peak discharge prediction

Predictive models for Air pollution levels, Water availability, climate change impacts, Waste management data analysis,

Module 5: AI and ML in Structural design and structural health monitoring (7 Lectures)
Implementing AI and ML in Structural Design task, AI and ML for structural analysis and simulation, Structural design optimization, Importance of predictive maintenance in civil infrastructure, Models for structural health assessment

Text Books

1. Gebrail Bekdas (2019), "Artificial Intelligence and Machine Learning applications in Civil, Mechanical and Industrial Engineering" IGI Global Publication
2. G. Tyfure (2012), "Soft Computing in Water Resources Engineering", WIT Press, Southampton, UK
3. N. K. Bose and P. Liang (1996), "Neural Networks Fundamentals with Graphs, Algorithms, and applications" Tata McGraw-Hill Publication.

Reference Books

1. B. Kosko (1993), "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", Prentice- Hall.
2. Publications in peer reviewed international unpaid journals.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand the fundamental concepts of artificial intelligence and machine learning and their relevance to civil engineering applications.

CO2: Analyze real-time traffic data and apply machine learning models to optimize traffic flow and control in transportation systems.

CO3: Implement AI-based approaches to optimize water resource management and predict water demand, air quality model, climate change in civil engineering projects.

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BTCVOE706D Introduction to Earthquake Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1 (6 Lectures)
Elements of seismology: Terminology, structure of the earth, causes of an earthquake, seismic waves, magnitude and intensity, seismograph, strong motion earthquakes, Accelerogram, prominent earthquakes of India.

Module 2 (6 Lectures)
Structural dynamics: Free and forced vibrations of single degree of freedom systems, un-damped and viscously damped vibrations, equations of motion, Duhamel integral.

Module 3: (6 Lectures)
Response Spectrum Theory: construction of Design Response Spectrum, effect of foundation and structural damping on design spectrum, design spectrum of IS 1893, evaluation of lateral loads.

Module 4 (6 Lectures)
Principles of Earthquake Resistant Design (EQRD), planning aspects, resistance of structural elements and structures for dynamic load, design criteria, ductile detailing of RCC members, energy absorption, provisions of IS 13920.

Module 5 (10 Lectures)
Construction aspects of masonry and timber structures, retrofitting and strengthening techniques of low cost and low-rise buildings, provisions of IS 4326.

Dynamic properties of soils, field and Laboratory tests, site evaluation, behavior under dynamic loads, effect on bearing capacity, settlement, liquefaction.

Text Books

1. IS 456, IS 1498, IS 1893, IS 1905, IS 2131, IS 13920, IS 4326 of recent editions, Bureau of IS,New Delhi.
2. Chopra A.K. (2001). *Dynamics of Structures*, 2nd Edi, Pearson Education Pvt. Ltd., India, ISBN 81-7808-472-4.

3. Mario Paz, (1985). *Structural Dynamics*, CBS Publication.
4. Arya A.S., (1987). *Elements of Earthquake Engineering*, South Asian Pub., New Delhi.

Reference Books

1. Clough R.W. and Penzien J.(1993), Dynamics of Structures, McGraw Hill New York
2. Humar J. L., (2002). Dynamics of Structures, 2nd Edition Swets and Zeitlinger, Netherlands.
3. Farzad Naiem, (2001). The Seismic Design Handbook, Kluwer Academic Pub. Massachusetts, ISBN: 0-7923- 7301-4.
4. Dowrick D. J., (1977). Earthquake Resistant Design for Engineers & Architects, John Wiley and Sons Ltd.
5. Pauley T. and Priestley M.J.N., (1992). Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons Inc., USA, ISBN 0-471-54915-0.
6. Nayak N. V., (1985). Foundation Design Manual, Dhanpat rai and Sons, Delhi.
7. Housner G.W. & Hudson D. E., (1950). Applied Mechanics- Dynamics, East-West Edition, N. Delhi.
8. Kramer S. L., (2003). Geotechnical Earthquake Engineering, Pearson Education.

Course Outcomes: On completion of the course, the students will be able to:

CO1 Capture complexities in earthquake resistant design of structures
CO2 Grasp Nature of earthquake vibration and associated forces on structures
CO3 Understand importance of designing the building to targeted seismic performance.

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BTCVOE706E Internet of Things

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(7 Lectures)**
Introduction to IoT Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs, Machine to Machine, Difference between IoT and M2M, Software define Network

Module 2: **(5 Lectures)**
Network & Communication aspects, Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

Module 3: **(6 Lectures)**
Challenges in IoT Design challenges, Development challenges, Security challenges, Other challenges.

Module 4: **(7 Lectures)**
Domain specific applications of IoT, Home automation, Industry applications, Surveillance applications, Other IoT applications

Module 5: **(7 Lectures)**
Developing IoTs Introduction to Python, Introduction to different IoT tools, developing applications through IoT tools, developing sensor-based application through embedded system platform, Implementing IoT, concepts with python.

Text Books:

1. Pethuru Raj and Anupama C. Raman "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by (CRC Press).
2. Samuel Greengard "The Internet of Things" MA: MIT Press, 2015.

Reference Books

1. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"
2. Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice

Course Outcomes: On completion of the course, the students will be able to:
CO1: Understand the concepts of Internet of Things
CO2: Analyze basic protocols in wireless sensor network
CO3: Design IoT applications in different domain and be able to analyze their performance
CO4: Implement basic IoT applications on embedded platform

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BTCVOE706F Tunnelling and Underground Excavation

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1 Tunneling Methods **(06 Lectures)**
Types and purpose of tunnels; factors affecting choice of excavation technique; Methods - soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.

Module 2 Tunneling by Drilling and Blasting: **(08 Lectures)**
Unit operations in conventional tunneling; Drilling – drilling principles, drilling equipment, drilling tools, drill selection, specific drilling; Blasting - explosives, initiators, blasting mechanics, blast holes nomenclature; types of cuts- fan, wedge and others; blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.

Module 3 Tunneling by Road headers and Impact Hammers **(08 Lectures)**
Cutting principles, method of excavation, selection, performance, limitations and problems. Tunneling by Tunnel Boring Machines: Boring principles, method of excavation, selection, performance, limitations and problems; TBM applications.

Module 4 Excavation of large and deep tunnels Introduction **(06 Lectures)**
Purpose and use of large and deep tunnels; excavation issues governing large and deep tunnels; excavation methods of large and deep tunnels - unit operations, different equipment, types of rock
pressure and methods to deal, roof and wall supports, case studies from hydel, road and rail tunnels.

Module 5 Shield Tunneling **(08 Lectures)**
Introduction; advantages of shield tunneling; classification; different types of shield tunneling techniques – open shield, close shield, half shield; conventional shields, special features in shield tunneling; factors affecting selection of a shield; slurry shield, earth pressure balance shield, slime shields, other shield development methods, problems encountered with possible remedies.

Text Books:

1. Srinivasan R., (2016). *Harbour, Docks and Tunnel Engineering*, Charotar Pub. House.
2. Saxena S. C. (2015). *Tunnel Engineering*, DhanpatRai Publications.
3. Tatiya R. R., (2013), *Surface and Underground Excavation*, CRC Press.

References:

1. Stack, B. (1982). Handbook of Mining and Tunnelling Machinery, Wiley, New York.
2. Chugh, C.P., (1977). Drilling Technology Handbook, Oxford & IBH Publication.
3. Bickel J.O. and. Kuesel T.R, (2018). Tunnel Engineering Handbook, CBS Publishers and Distributors Pvt. Ltd.
4. Brebbia C.A., Kaliampakos D., Prochazka P., (2008). Underground Spaces Design, Engineering and Environmental Aspects, WIT Press,

Web links:

1. https://www.isrm.net
2. www.nirm.in
3. http://umich.edu/~gs265/tunnel.html
4. http://se.sze.hu/images/ngm_se108_1/Tunnels_2015-03-20_Toth_1-Excavation.pdf
5. https://www.usbr.gov/ssle/safety/RSHS/sec23.pdf
6. https://www.osha.gov/Publications/osha3115.html

Course Outcomes: On completion of the course, the students will be able to:
CO1: Understand types of tunnels and tunneling methods conforming to site conditionsCO2: Investigate various tunneling operations and relevant machinery required
CO3: Understand methods and operations of excavating large and deep tunnels
CO4: Propose suitable tunneling and excavations methods to optimize the same

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BTCVOE706G Bamboo Construction Technology

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module – 1: Understanding bamboo plant **(lecture 6)**
Understanding Bamboo anatomy, Bamboo species in India & worldwide, Traditional use of bamboo in India & worldwide, Field visit to understand bamboo plant

Module – 2: Environmental impact **(lecture 6)**
Understanding environmental issues, Carbon Foot print of various building materials, Energy analysis, Response to Climate Change, environmental benefit of bamboo house

Module – 3: Bamboo as a construction material **(lecture 6)**
Various properties of bamboo, comparative analysis with steel, timber etc. structural properties of various bamboo species, Bamboo preservation techniques, Field visit to understand preservation of bamboo

Module – 4: Understanding bamboo **(lecture 6)**
Various joints in bamboo, Preparation of drawing for bamboo structures, structural analysis of bamboo structure, Various components in bamboo e.g. door, window, sky light, trusses etc. , Case study, Field visit to understand Bamboo house

Module – 5: Bamboo economy **(lecture 6)**
Estimation of bamboo structure, pre fabrication in bamboo construction, income generation from bamboo plantation, Case study – well known bamboo structure

Text books

1. David Farrelly, "The book of Bamboo ", Sep 2002, University of California press
2. Vinu Kale, " (Venu Bharati) '', CAPART publication , New Delhi
3. Jain A.K., "The Idea of Green Building" Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-256-4

Reference books

1. SP 7- National Building Code Group 1 to 5- B.I.S. New Delhi (Part 6 – section 3)
2. IS 9096 (2006) Preservation of Bamboo

Course Outcomes: On completion of the course, the students will be able to:
CO1: Understand need of Bamboo in construction.
CO2: Understand bamboo as a construction material.
CO3: Develop construction techniques in bamboo

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BTCVHM707A Essence of Indian Traditional Knowledge

Teaching Scheme: 1 Lecture / week

Course Contents

Module I **(04 Lectures)**
Ancient Education System in India, History of Indian Knowledge System, Sources of knowledge transmission and preservation, Indian Artistic Tradition: Chitrakala, Moorthikala, Vasthukala, Sthapthya, Sangeetha, Nruthya, Sahithya

Module II **(04 Lectures)**
Indian Linguistic Tradition (Phonology, morphology, syntax & semantics), Yoga & Holistic Health care

Module III **(04 Lectures)**
Philosophical Traditions in ancient India, Relevance in today's life

Module IV **(04 Lectures)**
Glimpses of ancient Indian science and technology, Ancient structures in India, Traditional materials, Construction styles and Techniques, Developments in construction materials, living styles and habitation, Town Planning, Case Studies

Module V **(06 Lectures)**

Developments in water supply, sanitation, irrigation and agriculture, Case Studies
Developments in transportation and communication, Case Studies

Text / Reference Books

1. V. Sivaramakrishna, "Cultural Heritage of India", Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edi., 2014
2. Swami Jitatmanand, "Modern Physics and Vedant", Bharatiya Vidya Bhavan
3. Fritz of Capra, "Tao of Physics"
4. Fritz of Capra, "The wave of Life"
5. 5Jha V. N. (English Trans,), "Tarkasangraha of Annam Bhatta", Inernational Chinmay Foundation, Velliarnad, Arnakulam
6. "Yoga Sutra of Patanjali", Ramakrishna Mission, Kolkatta
7. Jha GN (English Trans.), R N Jha, "Yoga-darshanam with Vyasa Bhashya", Vidyanidhi Prakasham, Delhi, 2016
8. Jha RN, "Science of Consciousness Psychotherapy and Yoga Practices", Vidyanidhi Prakasham, Delhi, 2016
9. P R Sharma (English translation), "Shodashang Hridayam"
10. Indian Journal of Traditional Knowledge
11. https://www.niscair.res.in/sciencecommunication/researchjournals/rejour/ijtk/ijtk0.asp
12. Swayam Course by Prof. D. P. Mishra, IIT Kanpur: https://swayam.gov.in/nd1_noc19_ae07/preview

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BTCVHM707B Foreign Language

Student may take foreign language course from online platform NPTEL/SWAYAM/any other approved foreign language course by University such as;

German I https://onlinecourses.nptel.ac.in/noc19_hs51/preview
Spanish https://onlinecourses.swayam2.ac.in/cec19_lg03/preview
French https://onlinecourses.swayam2.ac.in/cec19_lg04/preview
Japanese https://onlinecourses.nptel.ac.in/noc19_hs52/preview

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BTCVL708 Design and Drawing of Prestressed Concrete Structures Lab

Practical:2 Hours / Week Term Work: 50 Marks

Term work shall be based on the syllabus of BTCVC701. It consists of

1. Assignment on prestress Loss calculation
2. Assignment on stress calculation
3. Assignment on resistance of PSC members against shear and torsion.
4. Design, detailing and drawing of prestressed slab
5. Design, detailing and drawing of prestressed girder
6. Two site visit reports of R.C.C. and P.S.C structure.

There should be separate design data for a group size of **maximum four** students.

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BTCVL709 Professional Practices Lab

Practical:2 Hours / Week

Term work include detailed study and working of following set of assignments
1) Detailed estimate for a two storied RCC or load bearing wall building
2) Preparing detailed estimate for any four of the following:
   a) A small culvert
   b) A stretch of a road about 1 Km. long including earthwork
   c) A reach of canal about 1 Km. long
   d) A percolation tank
   e) A factory shed of steel frame
   f) Water supply scheme
   g) Drainage scheme
   h) Water Treatment plants.
3) Valuation report including valuation certificate for any one of the following:
   a) A building for residential purpose or commercial purpose
   b) A hotel
   c) A theatre
   d) Any one construction machine.
4) Drafting of Detailed specification for any five civil engineering items. This shall include at least one item each from Roads, Irrigation works, Water Supply, Sanitation and buildings
Assignment (1) and (2) shall include Rate Analysis of at least two items.

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BTCVP 610

Field Training /Internship /Industrial Training (Evaluation)

Students are expected to undergo industrial training for at least four weeks at factory / construction site / design offices or in combination of these. Training session shall be guided and certified by qualified engineer / architect / contractor in civil engineering. A neat detailed report on activities carried out during training is expected. Students should undergo training for minimum 4 weeks which can be completed partially in V Semester and VI Semester or in at one time after VI Semester. Evaluation will be done in VII Semester.

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BTCVS710 Seminar III

Teaching Scheme: 2 hours per week

Student shall visit to ongoing construction sites in field to witness and collect information from works of execution of roads. It is desirable to collect basic information on components of roads, construction machinery, etc. Intention of the work is to introduce the student to the sequential order of execution of road works, preparation of road alignment and various surveys

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BTCVM711 Project Stage I

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarise the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student.

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Semester VIII

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme$				Credits
			L	T	P	CA	MSE	ESE	Total	

BTCVSS801A	(Self-Study Course) #	Characterization of Construction Materials	02**	--	--	20	20	60	100	3
BTCVSS801B		Geo synthetics and Reinforced Soil Structures								
BTCVSS801C		Higher Surveying								
BTCVSS801D		Maintenance and Repair Of Concrete Structures								
BTCVSS801E		Structural Dynamics								
BTCVSS801F		Engineering Systems & Development								
BTCVSS801G		Sustainable River Basin Management								
BTCVSS801H		Modern Construction Materials								
BTCVSS801J		Advanced Town & Urban Planning								
BTCVSS802A	(Self-Study Course) #	Energy Efficiency Acoustics and Day lighting in Building	02**	--	--	20	20	60	100	3
BTCVSS802B		Environmental Remediation of Contaminated Sites								
BTCVSS802C		Remote Sensing Essentials								
BTCVSS802D		Mechanical Characterization of Bituminous Materials								
BTCVSS802E		Soil Structure Interaction								
BTCVSS802F		Design of Water Supply Systems								
BTCVP803	Project Stage-II	Project Stage II or Internship	--	--	24	100	--	100	200	12
		Total	04	--	24	140	40	220	400	18

BTCVSS801 A Characterization of Construction Materials

By Prof. Manu Santhanam, Prof. Piyush Chaunsali IIT Madras

The objective of the course is to introduce students to the characterization of construction materials and their behaviour, with a view of developing their understanding of the mechanisms that govern the performance of these materials. The course will be focused primarily on cement and concrete, and include the following techniques; the physics of the techniques and their application to cement science, including lab demonstrations and experiments will be covered.

Week 1: Introduction to course; Structure of Construction Materials – An Overview
Week 2: Calorimetry
Week 3: X-ray diffraction
Week 4: X-ray diffraction
Week 5: Thermal analysis
Week 6: Surface area measurement
Week 7: Optical microscopy
Week 8: Scanning electron microscopy

Week 9: Image analysis
Week 10: Spectroscopic techniques
Week 11: Mercury intrusion porosimetry
Week 12: Impedance analysis and ultrasonic methods

https://archive.nptel.ac.in/content/syllabus_pdf/105106200.pdf

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BTCVSS801 B Geo-synthetics and Reinforced Soil Structures

https://archive.nptel.ac.in/content/syllabus_pdf/105106052.pdf

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BTCVSS801 C Higher Surveying

https://archive.nptel.ac.in/content/syllabus_pdf/105103176.pdf

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BTCVSS801 D Maintenance and Repair of Concrete Structures

https://archive.nptel.ac.in/content/syllabus_pdf/105106202.pdf

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BTCVSS801 E Structural Dynamics

https://archive.nptel.ac.in/content/syllabus_pdf/105106151.pdf

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BTCVSS801 F Engineering systems and development

https://archive.nptel.ac.in/content/syllabus_pdf/110104074.pdf

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BTCVSS801 G Sustainable River Basin Management

https://nptel.ac.in/content/syllabus_pdf/105106145.pdf
https://onlinecourses-archive.nptel.ac.in/noc15_ce03/preview

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BTCVSS801 H Modern Construction Materials
https://archive.nptel.ac.in/content/syllabus_pdf/105106053.pdf

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BTCVSS802 A
Energy Efficiency Acoustics and Daylighting in Building
https://archive.nptel.ac.in/content/syllabus_pdf/105102175.pdf

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BTCVSS802 B Environmental Remediation of Contaminated Sites
https://archive.nptel.ac.in/content/syllabus_pdf/105107181.pdf

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BTCVSS802 C Remote Sensing Essentials
https://archive.nptel.ac.in/content/syllabus_pdf/105107201.pdf

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BTCVSS802 D Mechanical Characterization of Bituminous Materials
https://archive.nptel.ac.in/content/syllabus_pdf/105106203.pdf

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BTCVSS803 E Soil Structure Interaction
https://archive.nptel.ac.in/content/syllabus_pdf/105105200.pdf

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BTCVP803 Project Stage II or internship

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarise the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student in Industry based project or In-house project or Internship.

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